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ADDITIONAL NOTES ON LIRIODENDRON LEAVES

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(WITH PLATES I AND 2)

Any attempt at tracing the phylogeny of a species or group is always largely theoretical. The data upon which such speculations are based are always insufficient, especially when dealing with but one set of organs such as leaves. The extinct forms, generally the most essential for the correct understanding of the existing, are unknown for the most part and are represented by but here and there a fragment. At the same time phylogenetical hypotheses serve a coördinating purpose and are usually fertile with suggestions for further research.

The existing species of *Liriodendron* has never been adequately studied; especially is this true with regard to leaf-form, although the leaves furnish the only basis for comparison with the numerous fossil species. The response of organs such as leaves to their environment is generally rapid and we may be sure that similar changes in form may have appeared independently at any time when the proper environment was furnished; witness the interrelations of the variously denominated lobed leaves of the American Cretaceous. Thus it might seem that leaves afford little support for arguments as to ancestry or identity; and while this may be true when views are based on individual specimens or single "sports" it is not so far-reaching when arguments are supported by innumerable specimens, or series of specimens of a single species or genus showing constant gradations.

In a forthcoming article in the *Botanical Gazette* I have attempted a brief sketch of the probable relations of the various

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species of *Liriodendron* and I will not attempt anything further in that line at this time, but will confine myself in these notes to calling attention to several interesting forms of these leaves and briefly discussing the evidence they offer as to the probable relations of some of the ancient members of this genus.

While *Liriodendron Tulipifera* has long been known to have variable leaves the extent of this variability has not been dreamed of, nor any reason assigned which would account for it. Darwin's law that wide-ranging species are variable is fully carried out, but, on the other hand, Sedgwick's rule that old species have lost their variability is not fulfilled. In fact, quite the reverse holds good, *Liriodendron* having reached quite a respectable old age and still retaining its variability with all the vigor of its Cretaceous days.

The accompanying plates picture some especially interesting leaves, all one-fourth natural size, from a collection of several hundred. One of the most curious is the sport shown at Fig. 7. The left half of the blade is somewhat normal in shape but the right half is reduced to a narrow lanceolate strip, which in venation bears a striking resemblance to an ordinary cotyledon. We have reconstructed this leaf, Fig. 6, as if both halves of the blade were narrowed as is the right half; this gives us a leaf strikingly like what we consider the primitive *Liriodendron* of the early Cretaceous or Jura-Cretaceous to have been. For comparison we show an ordinary cotyledon at Fig. 8, which, as will be seen, is very similar to Fig. 6.

The original *Liriodendron* leaf was long and narrow and as time passed there was a progressive widening of the blade and a corresponding reduction of the apex. It has been suggested that the mucronate point which usually tips the midrib of the modern leaf is a surviving rudiment of this once pointed apex. However this may be, we often find leaves with the acute ancestral apex (Figs. 4, 11, 12, 13, 14, 15). While the leaves bearing the tips shown at Fig. 11 were otherwise normally shaped leaves of large size, and while the leaves shown at Figs. 14, 15 were otherwise normal, the remaining acute-tipped leaves are very suggestive. The leaf shown at Fig. 4 is almost identical with the

Cretaceous species *Liriodendron semialatum* Lesq.* and while Fig. 13 at first sight suggests *Aralia*, *Cissites* or some other but little understood fossil leaf, it would be the logical successor of the *semialatum* form, being a more robust leaf with a shortened length and an increased breadth. It is however a remarkable leaf to have been borne on a tulip-tree and was sent to me from Columbus, Ohio by Mrs. W. A. Kellerman, an amateur botanist of that place.

It has become more and more evident to paleobotanists that many of the numerous leaves variously referred to *Credneria*, *Cissites*, *Araliopsis*, *Grewiopsis*, *Sassafras*, *Platanus*, etc., are, at least some of them, unnaturally identified and their true affinities but little understood; and while perhaps all of these and other genera are badly in need of revision, it would be rash to attempt one without far more material than is at present available. In this connection several of our leaf specimens of *Liriodendron Tulipifera* are particularly interesting; at the same time I do not feel justified in anything further than calling attention to them. The first, Fig. 12, shows a very anomalous leaf, one which almost exactly corresponds with the *Cissites acuminatus* of Lesquereux.† It stands alone in its uniqueness, and yet the tree which furnished it bore many leaves of a similar general shape and with similar venation; they were of all sizes, some of the specimens being 130 mm. in length, and all were like the specimen in question except that the acute apex was cuneate or with a wide obtuse sinus, the resulting apical portions of the blade showing a slight tendency to become lobed.

Another specimen which is of interest in this connection is Fig. 16, on which I will offer no comment other than to call attention to its resemblance to *Cissites obtusilobus* Lesq.‡ From this leaf I have a complete series showing a gradual shortening of the midrib and a gradual lengthening of the lateral lobes, ending in the curious form shown at Fig. 18 in which the leaf consists of a single orbicular lobe on each side, the blade being nearly four times as wide as the midrib is long. Fig. 10 shows a leaf which,

* Fl. Dak. Gr. 204. pl. 25, f. 2-4; pl. 29, f. 3. (1891) 1892.

† Compare with fig. 3 on pl. 5, Cret. & Tert. Fl. 1883.

‡ Compare with fig. 5 on pl. 33, Fl. of Dak. Group. (1891) 1892.

if the lobes were altered as indicated by the dotted lines, would greatly resemble *Liriodendron giganteum* Lesq., particularly its variety *cruciforme*, in form, venation, and size.

Fig. 9 shows a modern leaf which is identical with that of *Liriodendron Meekii* Heer, and I find many modern leaves simulating this form more or less closely; as a rule, however, the lateral lobes are more oblique than in the form figured.

Figs. 1 and 3 show modern leaves which are identical with the *Phyllites obcordatus* of Heer, and which serve in a measure to confirm the reference of this species (of *Phyllites*) to *Liriodendron primaevum*. They also strengthen our conviction that *Liriodendron primaevum* Newb., *Liriodendropsis simplex* Newb., and *Liriodendropsis angustifolia* Newb. are valid species of *Liriodendron*, notwithstanding the fact that this view is criticized in some quarters.

Fig. 2 shows a modern leaf which has reverted to a still earlier stage in the history of the genus, the stage in which the simple ovate leaf had not yet become emarginate at the apex.

Fig. 5 shows a leaf of peculiar form related in a general way to the form figured at 12 as resembling *Cissites acuminatus*, but narrower, with a slightly emarginate apex and rounded lobes, the lateral margins and the primaries being somewhat more ascending. Finally, at Fig. 17, we picture the reduced, two-lobed, long-petioled, *Liriophyllum*-like leaf which is often found on the tulip-tree where there has been some diminution of nourishment, such as is caused by proximity to flowers or among leaves developed from forced buds. While this form is not constant in such situations, it is fairly common, there being an ever-present tendency to produce leaves of this shape or approximating it. The bud-scale of the blossom often bears at its apex a true leaf-blade almost exactly similar to the one here figured. A number of these leaves are shown in the September (1901) number of *TORREYA*.* They show that whereas a bud-scale has always been considered the morphological equivalent of a leaf, in this genus they are morphologically stipules, or modified leaf-segments.

* Berry, E. W. Notes on *Liriodendron* leaves. *TORREYA*, 1: 105-107, pl. 1, 2, 1901.



LIRIODENDRON LEAVES.